



*National Aeronautics and Space Administration
Goddard Earth Science
Data Information and Services Center (GES DISC)*

README Document for the High Resolution Infrared Radiation Sounder HIRS/Nimbus-6 Image Product

HIRSN6IM

Last Revised 12/18/2022

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Revision History

<i>Revision Date</i>	<i>Changes</i>	<i>Author</i>
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Table of Contents

1. Introduction.....	5
1.1 Data Product Description.....	5
1.1.1 The High Resolution Infrared Radiation Sounder.....	5
1.1.2 Nimbus-6 Overview.....	7
1.2 Algorithm Background.....	7
1.3 Data Disclaimer.....	8
2. Data Organization.....	9
2.1 File Naming Convention.....	9
2.2 Image Format and Structure.....	9
2.3 Key Science Data Fields.....	11
3. Data Contents.....	11
4. Reading the Data.....	11
5. Data Services.....	11
5.1 GES DISC Search.....	11
5.2 Documentation.....	11
5.3 Direct Download.....	11
6. More Information.....	12
6.1 Contact Information.....	12
6.2 References.....	12
7. Appendices.....	13
7.1 Acknowledgments.....	13
7.2 Acronyms.....	13

1. Introduction

This document provides basic information on the HIRS/Nimbus-6 Images of Brightness Temperature on 70 mm Film data product. These images serve as a companion to the HIRS/Nimbus-6 Level 1 Calibrated Radiances for the Global Atmospheric Research Program (GARP) data product.

1.1 Data Product Description

The High Resolution Infrared Radiation Sounder (HIRS) brightness temperatures were supplied by the experimenter, and displayed as 5" x 4" black and white negative and positive images. These were then stored on 70mm film rolls, each containing several hundred images, which have been digitally scanned as TIFF files. Each image is identified at the top by satellite and instrument as well as the interrogation orbit number. Also included is an indicator of type of data: full vertical scale (F) or at partial vertical scale (P). A full scale mode image will contain one orbit of data or 125 minutes of data, while a partial scale mode image will contain twice the vertical scale and thus requires two images for an orbit of data (the last 60 minutes on the first image, P1 and the remaining data on the second image, P2). There are 10 channels (swaths) for an orbit on each image, with a header identifying the channel (1-1, 6-6, etc.). An 18-step gray scale is found at the bottom. Time and geographic information is encoded in the center of the image. Conversion from the 18-step gray scale to brightness temperatures can be found in a table in each of the first six volumes of "The Nimbus 6 Data Catalog".

A total of four 70 mm rolls have been preserved, two contain data from 13 June 1975 to 14 February 1976 (orbits 20 to 3311) as negatives and positives, and the other two contain data from 14 February 1976 to 26 May 1976 (orbits 3311 to 4691) also as negatives and positives.

This product was previously available from the NASA National Space Science Data Center (NSSDC) as HIRS Brightness Temperatures on 70-mm Film, with the identifier ESAD-00094 (old id 75-052A-02A).

1.1.1 The High Resolution Infrared Radiation Sounder

The Nimbus 6 High Resolution Infrared Radiation Sounder (HIRS) measured radiances primarily in five spectral regions:

1. seven channels near the 15-micrometer CO₂ absorption band
2. two channels (11.1 and 3.7 micrometers) in the IR window
3. two channels (8.2 and 6.7 micrometers) in the water vapor absorption band

4. five channels in the 4.3-micrometer band
5. one channel in the visible 0.69-micrometer region.

The sounder consisted of a Cassegrain telescope, scanning mirror, dichromatic beam splitter, filter wheel, chopper, and associated electronics. The HIRS scanned the earth's surface in a plane normal to the spacecraft's orbital path with a maximum scan angle of 30 deg to either side of nadir to provide data with a spatial resolution of 25 km.

The instrument was turned off as a precautionary move on May 27, 1976, when the filter chopper motor failed. The original principal investigator for the HIRS experiment was Mr. William L. Smith.

1.1.2 Nimbus-6 Overview

The Nimbus-6 satellite was successfully launched on June 12, 1975. The spacecraft included nine experiments: (1) a Temperature-Humidity Infrared Radiometer (THIR) for measuring day and night surface and cloud top temperatures, as well as the water vapor content of the upper atmosphere, (2) a High-Resolution Infrared Radiation Sounder (HIRS) for determining vertical temperature profiles, and the distribution of water vapor in the atmosphere, (3) the Scanning Microwave Spectrometer (SCAMS) for obtaining vertical profiles of temperature in the troposphere and abundances of liquid water and water vapor, (4) an Electrically Scanning Microwave Radiometer (ESMR) for determining liquid water content of clouds, the distribution and variation of sea ice cover, and land surfaces characteristics, (5) the Earth Radiation Budget (ERB) experiment for accurate measurements of radiation from the sun and earth, (6) a Limb Radiance Inversion Radiometer (LRIR) for determining the vertical distribution of temperature, ozone and water vapor in the stratosphere and lower mesosphere, (7) a Pressure Modulator Radiometer (PMR) for measuring the temperature structure of the upper stratosphere and mesosphere, (8) the Tropical Wind Energy Conversion and Reference Level Experiment (TWERLE) for determining upper atmospheric winds in the tropics, pressure gradients, and provide a reference level in-coordination with in-situ balloon measurements and (9) a Tracking and Data Relay Experiment (T&DRE) for demonstrating data communication from a low-orbiting spacecraft through a synchronous spacecraft to a ground telemetry station.

The orbit of the satellite can be characterized by the following:

- circular orbit at 1100 km
- inclination of 100 degrees
- period of an orbit is about 107.3 minutes
- orbits cross the equator at 26 degrees of longitude separation
- sun-synchronous

1.2 Algorithm Background

The Nimbus-6 HIRS data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 360 computers. The data were then copied to images and saved on 70 mm film strips. Detailed information on the HIRS data processing can be found in the Nimbus-6 Users' Guide Section 3.

1.3 Data Disclaimer

The data should be used with care and one should first read the Nimbus-6 User's Guide, section 3 describing the HIRS experiment. Users should cite this data product in their research.

William L. Smith (2022), HIRS/Nimbus-6 Images of Brightness Temperature on 70 mm Film V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: [Data Access Date], 10.5067/9WU2QOOK6100

2. Data Organization

The HIRS/Nimbus-6 Image product spans the time period from June 13, 1975 to May 26, 1976.

2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>_Box<Num>_<BeginOrbit>_<EndOrbit>_<Instrument><Type>_<Sequence>.<Suffix>

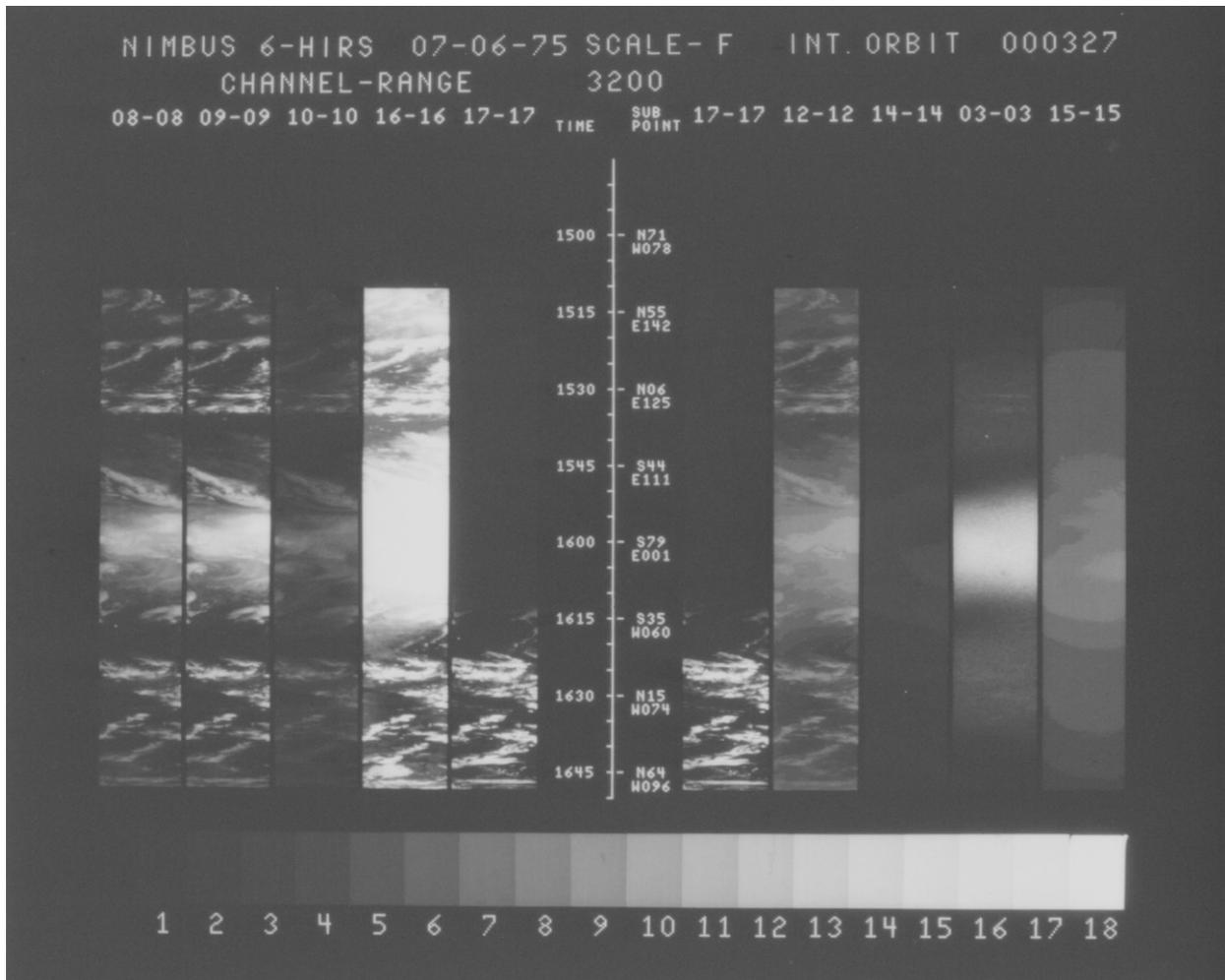
where:

- o Platform = name of the platform or satellite (always N6)
- o Num = number of box originally containing film roll (8)
- o BeginOrbit = 2-5 digit integer
- o EndOrbit = 2-5 digit integer
- o Instrument = name of the instrument (always H = HIRS)
- o Type = film type (Pos = positive or Neg = Negative)
- o Sequence = sequence number of scan in zip directory, 3 digit integer
- o Suffix = the file format (always tif, indicating TIFF file)

File name example: N6_B8_0020_3311_Hneg.zip

2.2 Image Format and Structure

Image scans are stored as TIFF files and have been combined into eight ZIP files. Four of these contain film negatives, and the other four contain film positives. Each ZIP file contains about 600 to 800 scans, with each scan containing 2 to 3 full images. When unzipping the ZIP files there will be a directory containing two subdirectories: TIF with the scanned images, and NIMBUS_SUPPORT with information about how the images were scanned. Each scan is about 10200 x 2778 pixels, and the 2-3 images within are about 2650 x 2125 pixels in size. The original image prints were 5" x 4" in size. The Nimbus-6 HIRS image layout is shown below:



The image contains the following information on the top line:

- **NIMBUS 6-HIRS:** satellite and instrument identifier
- **DATE:** 2 digit month, day and year
- **SCALE:** F (full 125 minutes of data) or P1/P2 (partial part 1/part2 65 minutes of data)
- **INT. ORBIT:** 6 digit interrogation orbit number

In the middle are 10 swath strips, 5 on the right and 5 on the left with a line in between with hash marks with time (hhmm UTC) at 5 minute increments and sub-satellite latitude/longitude points. Each swath strip represents one of the instruments 17 channels (0.69 and 3.7 to 15 micrometers). The number before the hyphen is the channel, the number after the hyphen is the computer code for the gray scale at bottom, with a total of 21 options.

At the bottom is the 18 step gray scale. See Nimbus-6 Users Guide for channels and data value range for each step (may be different depending on image).

2.3 Key Science Data Fields

The primary science data fields in these images are brightness temperatures in Kelvin.

3. Data Contents

The granularity of this data collection is one orbit (approximately 107 minutes).

4. Reading the Data

The image scans can be read using any software package that is able to display TIFF files. Individual TIFF files need to be unzipped using ZIP software.

5. Data Services

5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

<https://disc.gsfc.nasa.gov/>

5.2 Documentation

The data product landing page provides information about the data product, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/HIRSN6IM_001.html

5.3 Direct Download

The data product is available for users to download directly using HTTPS:

https://acdisc.gesdisc.eosdis.nasa.gov/data/Nimbus6_HIRS_SCAMS_Level1/HIRSN6IM.001/

6. More Information

6.1 Contact Information

Name: GES DISC Help Desk

URL: <https://disc.gsfc.nasa.gov/>

E-mail: gsfc-help-disc@lists.nasa.gov

Phone: 301-614-5224

Fax: 301-614-5228

Address: Goddard Earth Sciences Data and Information Services Center

Attn: Help Desk

Code 610.2

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6.2 References

W. L. Smith, P. G. Abel, H. M. Woolf, A. W. McCulloch, and B. J. Johnson "The Nimbus-6 User's Guide - Section 3: The High Resolution Infrared Radiation Sounder (HIRS) Experiment", NASA Goddard Space Flight Center, February 1975, Pages 37-58

"The Nimbus-6 Data Catalog - Volumes 1-12", NASA Goddard Space Flight Center, November 1975 to March 1978

7. Appendices

7.1 Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

7.2 Acronyms

DAF: Data Acquisition Facility

EOS: Earth Observing System

ESDIS: Earth Science and Data Information System

GES DISC: Goddard Earth Sciences Data and Information Services Center

GSFC: Goddard Space Flight Center

HIRS: High Resolution Infrared Radiation Sounder

L1: Level-1 Data

NASA: National Aeronautics and Space Administration

QA: Quality Assessment

TIFF: Tag Image File Format

UT: Universal Time